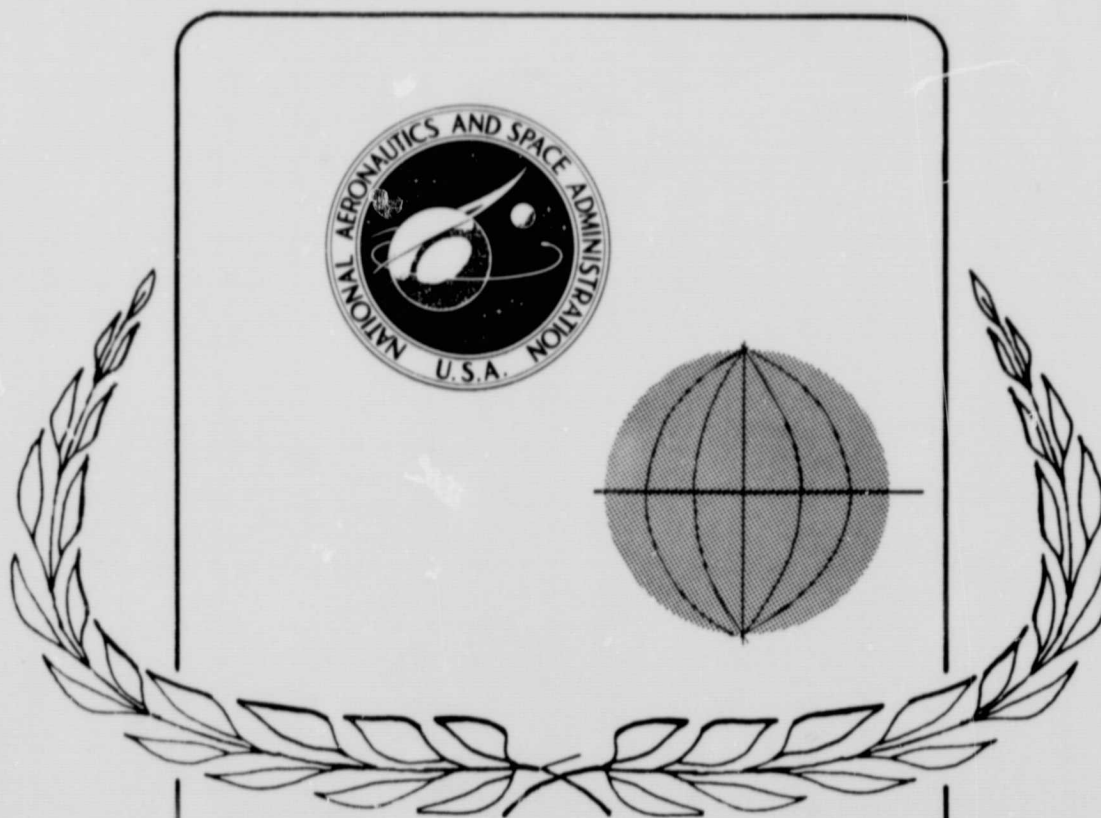


General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.
- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.
- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.
- This document is paginated as submitted by the original source.
- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.



INTERNATIONAL PROGRAMS

FACILITY FORM 602

N70-43072	
(ACCESSION NUMBER)	(THRU)
19	1
(PAGES)	(CODE)
Tmx 66398	34
(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)

...*"cooperation with other nations and groups of nations."*

— U. S. SPACE ACT 1958

September 1970



INDEX

(Editors: This fact sheet contains information on NASA's international space activities. It is suggested that it be retained in your files.)

Background on the international program	<u>Page</u> 1-4
Summary of NASA's international space activities	5
Cooperative international satellite and probe projects	6
International experiments on NASA satellites	7
Other cooperative international programs	8-9
Foreign civilian space budgets	10
International program summary	11-15
Cooperative international aeronautics research	16-17

SEPTEMBER 1970

INTERNATIONAL PROGRAMS

The National Aeronautics and Space Administration's international activities are based on the National Aeronautics and Space Act of 1958 which provides that United States space activities be conducted so they contribute materially to cooperation with other nations and groups of nations.

NASA has entered into almost 250 agreements for international space projects; orbited foreign satellites; flown foreign experiments on its spacecraft; participated in more than 500 cooperative scientific rocket soundings from sites in all quarters of the world, and involved more than 50 foreign scientists in the analysis of lunar surface samples.

Direct daily reception of data from U.S. weather satellites is carried out by some 50 countries. Major ground stations in a dozen countries have participated in the experimental testing of communications satellites. Foreign nationals participate extensively in the operation of NASA overseas tracking and data acquisition facilities.

Cooperative aeronautic projects have been carried out with Canadian, French, German, and British agencies which are contributing importantly to the development and testing of a variety of V/STOL aircraft.

These projects benefit both the United States and her cooperating partners.

There are cost savings, for example, when Canada assumes responsibility for a series of satellites in the NASA ionospheric research program, when Germany cooperates on a major solar probe program, and when countries such as Brazil, India, and Norway provide extensive range support for sounding rocket projects which require their unique geographical locations.

There are scientific benefits when foreign experimenters win opportunities to fly their instruments on NASA satellites after competitive selection. Scientific benefits have also come, for example, from wholly new data obtained from the Canadian topside sounder satellites and the Italian atmospheric density satellites, from such new techniques as the German barium cloud procedure for investigating the Earth's magnetic field in space, and from the global observations which have been organized in support of radio propagation and geodetic satellite programs.

There are technological benefits when, in joint projects, Canadian engineers pioneered in swept-frequency ionospheric sounders and in extensible spacecraft booms and French engineers advanced the state of the art in balloon technology, remote sensors, spacecraft engineering, and aircraft hazard testing.

Should other industrialized countries decide to allocate larger amounts of their resources to cooperative programs in space, the way will be open for their participation in the development of the large-scale systems which should pay important scientific and technological dividends in the future.

The U. S. looks forward to the time when there will be participation by astronauts from other countries in NASA flights.

There are immediate projects and prospects in the practical applications of space which are important to both advanced and developing countries.

An experimental meteorological satellite and balloon program with France is called Project EOLE. NASA will launch a French satellite to track several hundred balloons to study the global circulation of the winds.

NASA has entered into a far-reaching venture with India which will make NASA's ATS-F satellite available for an experiment in instructional TV broadcasting to some 5,000 remote Indian villages. India assumes responsibility for the construction of ground transmitters, the design and production of augmented TV receivers, the planning of instructional programs, and the logistics required to coordinate and support all elements of the system.

In the field of earth resources survey by satellite, NASA has undertaken cooperative projects with Brazil and Mexico designed to acquaint scientists and policy makers overseas with the potential of remote sensing. Brazilian and Mexican teams have been trained in remote-sensing techniques, have established ground test sites in their own countries, and are acquiring and instrumenting their own experimental aircraft.

To follow through on the President's statement to the United Nations in September 1969 that this country would share the benefits of earth resources satellites, NASA is undertaking a wide range of supporting actions: briefing the UN Outer Space Committee at the Manned Spacecraft Center's earth resources facilities, adding the earth resources disciplines to the scope of the International Graduate Fellowship Program, and planning an international workshop in 1971 to review the status of research and experimentation in this new field. NASA is providing technical assistance to India in the aircraft survey of a coconut palm blight in Kerala State so that its spread may be mapped and controlled.

NASA is considering a proposal to launch a French synchronous meteorological satellite as a joint contribution to GARP, the Global Atmospheric Research Program. NASA experts, joined by representatives of the Federal Aviation Agency, have met informally with ESRO and representatives of European aviation agencies to consider mission requirements for a possible pre-operational air traffic control satellite system for the North Atlantic.

Four presidents and many members of the Congress have supported NASA cooperation in space activities with the Soviet Union. Bilateral agreements for four projects in satellite meteorology, communications, geomagnetic surveying, and space biology and medicine resulted from talks from 1962-65. These agreements provided for coordinated efforts rather than integrated projects. Progress under these limited agreements has been disappointing. NASA has recently invited new initiatives in space cooperation from the Soviet Academy of Sciences. It is not yet known whether these new initiatives will lead to more fruitful discussions and relationships between the U.S. and the Soviet Union in space.

NASA has established through its international programs of the sixties a broad base of institutions, facilities, competence, and patterns of cooperation from which it can move forward in the future. It is engaged in a major new effort to increase international cooperation in the seventies by extending its activities with the other nations of the west to include participation in the development and use of major new space systems and in the experimental development of new applications of space technology. Its objective is to bring about a greater sharing of both the costs and the benefits of the exploration and utilization of space and to seek new paths of cooperation with the Soviet Union.

As in all matters involving international agreement, progress will take time, but the 1970's should see major advances in international space cooperation beyond the substantial achievements of the 1960's.

NASA'S INTERNATIONAL SPACE ACTIVITIES

SUMMARY (Cumulative from 1958-1970)

TOTAL Countries cooperating in
some form with NASA 74**

I. Total Countries* which have entered into:

Cooperative Project Agreements	25
Tracking and Data Acquisition Agreements	21
National Geodetic Satellite Program Agreements	13

II. Total Countries* in which scientists
participate in:

Ground-based Programs	71
Personnel Exchanges	39

III. Countries which exchange scientific
and technical information 62

IV. Countries*** which have sent visitors
to NASA 125

GRAND TOTAL 130**

-
- * Includes European Space Research Organization (ESRO)
** Duplications eliminated
*** Includes ESRO and European Launcher Development
Organization (ELDO)

COOPERATIVE SATELLITE AND PROBE PROJECTS

Countries (including ESRO as one) under agreement with NASA**

6

International Satellites and Probe agreements

24#

International Satellites already launched by NASA vehicles:

Canada:

Alouette I
Alouette II
ISIS-I

September 29, 1962
November 29, 1965
January 30, 1969

France:

FR-I

December 6, 1965

Germany:

AZUR I

November 7, 1969

Italy:

San Marco I (prototype)
San Marco II

December 15, 1964
April 26, 1967

United Kingdom:

Ariel I
Ariel II
Ariel III

April 26, 1962
March 27, 1964
May 5, 1967

ESRO:

IRIS
Aurorae
HEOS-I
BOREAS

May 17, 1968
October 3, 1968
December 5, 1968##
October 1, 1969##

TOTAL 14

** In addition, NASA has an agreement with the Soviet Academy of Sciences for "Coordinated" projects.

Includes three reimbursable launchings: HEOS-I, BOREAS and TELESAT Canada.

Reimbursable launchings

EXPERIMENTS ON NASA SATELLITES

Countries participating 5

International experiments selected 22

International experiments flown:

France:

OGO-II	October 14, 1965
OGO-IV	July 28, 1967
OGO-V	March 4, 1968
OSO-V	January 22, 1969
OGO-VI	June 5, 1969

Italy:

OSO-VI	August 9, 1969
--------	----------------

Netherlands:

OGO-V	March 4, 1968
-------	---------------

Switzerland:

Apollo 11 and 12	July 16, and November 14, 1969
------------------	--------------------------------

United Kingdom:

Explorer XX	August 25, 1964
Explorer XXXI	November 29, 1965
(2 experiments)	
OSO-IV	October 18, 1967
(2 experiments)	
OGO-V	March 4, 1968
(2 experiments)	
OSO-V	January 22, 1969
OSO-VI	August 9, 1969

TOTAL 17

SOUNDING ROCKET PROJECTS

Countries under cooperative agreement with NASA and executing cooperative launchings	19
Total cooperative sounding rockets launched*	526

COMMUNICATIONS SATELLITES

Countries under agreement with NASA to provide ground stations for cooperative testing of experimental COMSATS and implementing the agreement	12
---	----

NATIONAL GEODETIC SATELLITE PROGRAM

Countries which have agreed to temporary location of BC-4 camera installations.	23
---	----

TRACKING AND DATA ACQUISITION

Countries in which NASA TDA stations are now operated.	15**
NASA overseas TDA stations.	25**

-
- * Does not include NASA launchings at Churchill Research Range, Canada.
- ** Includes NASA electronic stations and SAO optical stations.

METEOROLOGICAL RESEARCH

Countries which have taken part in synchronized gathering of data with NASA meteorological satellite photography and countries known to have used APT 60

OTHER COOPERATIVE ASSOCIATIONS

Countries which have participated in ground-based activities relating to ionospheric satellites, geodetic satellites, solar eclipse experiments, Moonwatch and aeronautics. 52

Countries which are participating in the lunar sample program 16

PERSONNEL EXCHANGES

Total countries (including ESRO as one) which have participated in personnel exchanges programs 39

International Resident Research Associates in NASA Centers and JPL 422

NASA International Graduate Fellows in U.S. Universities 244

Foreign technical trainees at NASA Centers in support of cooperative projects and ground facility operations 481

Countries which exchange scientific and technical information 62*

Informal exchange arrangement with organizations 280

Exchange services provided to additional organizations 109

Countries** which have sent visitors to NASA 125

VISITS PROGRAM

Visitors	approximately	40,100
Current annual rate	approximately	2,900

* Duplications eliminated

** Includes ESRO and ELDO

FOREIGN CIVILIAN SPACE BUDGETS

(Unofficial Estimates in Millions of Dollars)

<u>Country</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>
France	\$99.6	\$119.1	\$108.
Germany	69.5	85.0	87.8
U.K.	50.9	56.5	49.7
Japan	18.7	20.4	25.6
Canada	15.0	17.7	18.0
Belgium	6.8	7.2	7.4
Italy	19.0	18.6	16.2
Netherlands	6.9	8.5	8.9
Australia	5.0	5.0	5.0
Sweden	2.9	3.4	3.7
India	2.8	2.7	
Switzerland	1.8	1.9	
Denmark	1.7	1.5	1.5
Brazil	1.5	1.5	2.8
Spain	1.4	1.6	1.9
Argentina	.6	.6	.6
Norway	.4	.5	.5
Pakistan	.1	.1	.1
Mexico			1.6
TOTALS	\$304.6	\$351.8	\$339.3
<u>Multinational Organizations*</u>			
ESRO	\$ 48.0	\$ 53.0	\$ 49.0
ELDO	96.0	90.0	81.4
TOTALS	\$144.0	\$143.0	\$130.4

*Contributions already included in country totals.

INTERNATIONAL PROGRAM SUMMARY

The 1958 legislation creating NASA provided that "the aeronautical and space activities of the United States shall be conducted so as to contribute materially to...cooperation by the United States with other nations and groups of nations in work done pursuant to this act and in the peaceful application of the results thereof." NASA's international programs, undertaken to implement this directive, can be categorized in three principal areas: space sciences, space applications, and the ground support of space operations. A cardinal principle of these cooperative programs is that each side fund its own participation.

What follows is a brief, selective summary description of these programs.

I. SPACE SCIENCES

Cooperative satellite projects are a major element of international space science programs. In these projects, the foreign participant contributes the satellite while NASA contributes the launching. NASA in effect gets a free satellite, while the cooperating partner gets a free launching. To date there have been 12 such cooperative launchings of spacecraft built by the United Kingdom, Canada, France, Italy and Germany, as well as by the European Space Research Organization (ESRO). Nine additional cooperative satellite projects have been agreed, and prospects for the continuation and growth of cooperative satellite programs are excellent.

The US and Germany agreed last year to the most ambitious cooperative spacecraft effort yet undertaken. In this project, called HELIOS, two German spacecraft, carrying seven German and three US experiments, will be launched by NASA to make physical measurements within about 28,000,000 miles of the sun, closer than any spacecraft has flown before. HELIOS will complement the NASA Pioneer series of spacecraft in providing total solar system coverage. Of the total project cost, estimated to exceed \$100,000,000, Germany will bear the major portion.

In addition to cooperative satellites, NASA also solicits foreign proposals for experiments to be flown on NASA satellites. Twenty two such experiments from France, the UK, Italy, the Netherlands and Switzerland have been selected on their merits through competition with US and other proposals. Of these, 17 have been flown to date. Financial support was provided by the foreign sponsors. Through this program, foreign scientists have opportunities to participate in useful flight research, while NASA gains access to outstanding space science capabilities in the international community. The flight opportunity is made available at no cost to the foreign cooperators who, in turn, make their experiments available at no cost to NASA.

The launching of foreign scientific spacecraft on a cost-reimbursable basis is an international activity of growing importance. Already two ESRO satellites have been successfully orbited under such arrangements and four more are planned for the future. Discussions are also underway with other nations.

The program to analyze lunar samples returned in the Apollo program now includes 55 approved Principal Investigators from 16 countries--Australia, Belgium, Canada, Czechoslovakia, Finland, France, Germany, India, Italy, Japan, Korea, Norway, South Africa, Spain, Switzerland and the UK. Thus nations around the world are afforded the opportunity to share, in a scientifically significant way, in one of man's truly great endeavors. These investigators, selected on the merits of their proposals and with no U.S. financial support, are performing a full range of physical, chemical, mineralogical and biological experiments on the lunar samples, along with their 139 American colleagues. Other important international participation in Apollo 11 included:

- A Swiss solar wind experiment placed on the lunar surface and later retrieved by the astronauts.

- A laser reflector left on the lunar surface and announced as available to all countries (and already in use by France).

Sounding rocket programs represent a broad area of international cooperation, some nineteen countries having joined with NASA in projects of mutual interest. Because of the low costs of sounding rocket work, countries without the resources for satellite projects are able to participate directly in valid scientific space flight projects. In addition, the small launching facilities developed in such countries as Brazil, India, Argentina and Pakistan have been available to NASA sounding rocket programs that have required special launch locations for research into polar, auroral and equatorial phenomena. More than half of NASA's total sounding rocket effort is in collaboration with foreign partners, with launchings in 14 different countries.

More than 40 countries have been involved in a wide range of cooperative ground-based observations, as distinguished from flight projects. Scientists abroad have been able to carry out such observations in support of orbiting satellite projects in such fields as ionospheric studies and geodesy. Many of these complementary ground activities have actually been necessary to achieve flight program objectives.

A variety of research and training opportunities for foreign scientists and engineers in space-related science and engineering at US universities and NASA centers are available and have so far involved more than 1,000 individuals from some 40 countries. In many cases the participants in these programs have returned to their countries to serve as the nucleus around which national space organizations and programs have developed.

II. SPACE APPLICATIONS

Experimental communications satellites have for the past decade been a major element in international collaboration. In the early Relay, Telstar and Syncom experiments a dozen countries built ground terminals at their own expense to work with NASA in testing these satellites. From this beginning has evolved the 74-member INTELSAT consortium which has greatly expanded telecommunications capacity internationally, reduced costs substantially, and provided real-time TV coverage in large portions of the globe. NASA also provides reimbursable launchings for foreign national communications satellites; UK and Canada satellites will be the first.

Under a major new agreement with India, NASA will make available its ATS-F satellite for a one-year Indian instructional television experiment. Villages equipped with augmented TV receivers will receive programs on population control and agricultural productivity while the technical feasibility of satellite TV direct broadcast is tested in an operational setting.

NASA's efforts in the weather satellite and rocket field have been strongly influenced by international concerns. Meteorological satellites now routinely deployed have been designed so that nations everywhere can use inexpensive (or easy-to-build) Automatic Picture Transmission (APT) sets to obtain daily weather prospects directly from US satellites. These sets are in use in some 50 countries. And regular, coordinated weather rocket soundings on a North-South line in the Western Hemisphere have been undertaken in an Inter-American Experimental Meteorological Rocket Network (EXAMETNET). Since inception in 1966, Argentina and Brazil have launched more than 100 rockets, synchronized with similar launchings from various US sites.

NASA is also engaged with France in a cooperative meteorological satellite and balloon project, EOLE, to test the feasibility of such a system for tracking global winds. Balloon and satellite launchings are scheduled for late this year. Cooperation in an advanced synchronous weather satellite project is under discussion with France.

Pre-satellite emphasis in the Earth Resources Surveys (ERS) area has been on actions to inform the international community about the evolving US program, to provide orientation and training, and mount aircraft-based programs in preparation for the use of later satellite data. Cooperative aircraft programs with Brazil and Mexico are proceeding and remote sensing techniques are being made available to India for the identification of areas of coconut palm blight in Kerala state. In addition, the US is cooperating with Canada in the development of sensors, NASA's fellowship program is being extended to cover remote sensing-related disciplines, and briefings have been arranged for international groups, such as the UN Outer Space Committee.

III. SPACE OPERATIONS SUPPORT

The tasks of tracking, communicating with and acquiring data from the multitude of NASA's manned and automated spacecraft has required the extensive and intimate participation of 21 countries. Some 25 stations around the world are at present operated with active support, and often direct staffing, by nationals of the host countries. In several locations, the costs of operating the stations are borne by the host countries. NASA maintains close ties with the ESRO and French tracking networks, and specific project support exchange arrangements are increasing in number.

Extensive operational arrangements have been made with dozens of countries in Africa, Asia and South America for the staging and overflight of US aircraft in conjunction with contingency assistance operations for the Mercury, Gemini and Apollo programs.

COOPERATIVE INTERNATIONAL AERONAUTICS RESEARCH

France

NASA and ONERA, the French civilian aeronautics research agency, are conducting a cooperative wind tunnel research project to test rigid and flexible tilt rotors for V/STOL aircraft. The rotors are being tested with various distributions of twist and camber, simulating the effect of aeroelasticity on blade shape. This research will contribute to rotor-prop design state-of-the-art. High speed tests (approximately 200-500 knots) are being conducted in ONERA's S-1 wind tunnel, and low speed tests (0-200 knots) in the Ames 40' x 80' tunnel. NASA is providing the rotors. ONERA is conducting the S-1 wind tunnel tests at no charge to NASA. Data resulting from the program will be shared.

NASA has contracted with LTV (subcontract with the Giravions-Dorand Company of France) to look into the most promising applications of the Jet-Flap Rotor, which was designed and developed by Giravions-Dorand.

In 1966 NASA contracted for 20 hours of flight time on the Breguet 941 STOL aircraft. This aircraft was recently used by Eastern and American Airlines to study the possible application of a STOL aircraft for commercial short-haul transport use in the Northeast Corridor.

Germany

NASA and the BMBW (German Ministry for Education and Science) have agreed to two cooperative efforts related to the Do-31 aircraft, a unique advanced jet V/STOL transport. In the first, the stability, control, and handling qualities of the Do-31 have been studied during landing, transition and descent phases of flight on the NASA/Ames 6°-of-freedom simulator. In the second, NASA pilots will fly the Do-31 for approximately 12 1/2 hours. The purpose of the flight program is to examine the handling qualities and the performance limitations of the Do-31 under various VTOL and STOL descent and ascent conditions. Terminal area operating problems of the aircraft will also be studied. NASA's contribution is to take the form of a \$700,000 contract with Dornier, the Do-31 developer. Do-31 development was funded by the German Government at a cost of over \$40 million. The present flight test program is being funded by the Germans at a level of approximately \$6 million.

United Kingdom

NASA and the UK Ministry of Technology (Mintech) are cooperating in testing the British Hunting-126 Jet-Flap STOL aircraft in the Ames 40' x 80' wind tunnel.

NASA and Mintech cooperated in conducting runway tire traction tests at Wallops Station in June 1968. For these studies the British provided a Heavy Load Friction Trailer and associated equipment. Follow-up tests as an extension of this program were conducted in the UK during the summer of 1969.

The University of Southampton's Institute of Sound and Vibration Research is one of the foremost research laboratories in the world on aircraft noise problems. NASA has contracted with the Institute for noise research and two Langley engineers are pursuing graduate level research at the University.

In 1966, Defense Dept. transferred to NASA two Hawker-Siddeley P-1127 aircraft for NASA to study the vectored thrust VTOL characteristics of the aircraft under visual and simulated IFR conditions. This program is to extend until 1971 with the intention of accumulating about 125 flight hours.

In 1966 and 1967 the then Ministry of Aviation (now part of Mintech) and NASA cooperated in conducting research on disturbances associated with severe thunderstorms, mountain waves, and tropical storms. Both British and US aircraft were used.

Canada

NASA and the Canadian aeronautical research and development authorities are conducting a wind tunnel research project to study the "augmentor wing" concept, a promising wing configuration for STOL aircraft that originated with the De Havilland Company of Canada. A second phase of this project, involving the testing of the concept on a small research vehicle, is presently under discussion.